HOST RANGE OF THE ERYSIPHACEAE OF OHIO[1, 2]

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ABSTRACT

Twenty-four species of powdery mildew fungi have been recognized on 305 host species in Ohio. Included are more than 320 host-fungus associations. Many are new records for Ohio and several are first reports for the United States.

The Erysiphaceae are a family of obligately parasitic fungi which cause the diseases commonly known as the powdery mildews. Hundreds of kinds of angiosperms are included among the hosts of these fungi. The powdery nature of most of these fungi is due to the great number of conidia produced on the surface of the host. The perfect stage of a powdery mildew is a perithecium, sometimes called a cleistothecium. A mature perithecium has appendages varying in character and which, together with the number of asci developing in the perithecium, form the basis for separation of the genera. A monograph by Salmon (1900) has been the basis for most of the taxonomic work on this group of fungi. For discussions of the biology of the powdery mildew fungi, the excellent reviews of Yarwood (1957) and Schnathorst (1965) should be consulted.

Some of the powdery mildew diseases cause serious losses of cultivated plants. In Ohio, powdery mildew may be destructive on wheat, barley, cucurbits, and rose. Powdery mildew on the greenhouse rose is often the major disease of the crop. Other floral crops in the greenhouse, such as chrysanthemum, hydrangea, and snapdragon, may at times be seriously affected.

Perithecia rarely or never form in connection with powdery mildew as it develops on some hosts in some areas of the world. In Ohio, perithecia have never been observed as powdery mildew develops on red clover, cucurbits, chrysanthemum, greenhouse rose, snapdragon, bean, and many other hosts. Many plants are known to be hosts for more than one species of a powdery mildew fungus, and when perithecia are absent, one cannot usually be certain of the identity of the fungus. In such cases, the fungus is commonly listed as a species in the form genus, *Oidium* sensu Saccardo. Errors in identification may occur when the powdery mildew is identified solely on the basis of its host.

The usefulness of the imperfect states, in the identification of species of powdery mildew fungi, has been considered by several workers (Blumer, 1933; Clare, 1964; Homma, 1937; Schmitt, 1957; Stavely and Hanson, 1966; Yarwood, 1957; Zaracovitis, 1965). The size and shape of conidia, formation of conidia singly or in chains, type of appressorium on the epiphytic hyphae, presence or absence of well-developed fibrosin bodies, germ tube morphology, and rate of germination, are some of the characteristics which have been studied.

Clare and Zaracovitis have provided examples of the value of some of these characteristics in identifying a number of powdery mildews of economic importance. These authors discussed the usefulness of germ tube morphology, rate of germination, presence of well developed fibrosin bodies, and type of appressorium, in identifying the powdery mildews on cucumber. Both *Erysiphe* and *Sphaerotheca* are known to occur on cucurbits. In the United States, *Erysiphe cichoracearum* has been considered to be the cause of cucurbit powdery mildew even though perithecia are seldom observed. Recent reports (Kable and Ballantyne, 1963;

[1]Paper No. 719, Department of Botany and Plant Pathology, The Ohio State University.
[2]Manuscript received February 22, 1966.

Yarwood and Gardner, 1964) based on studies of the conidial stage, indicate that *Sphaerotheca fuliginea* may be quite common on cucumber in the United States. I have checked three collections of cucurbit powdery mildew from Ohio and the characters are those of *Sphaerotheca* and not *E. cichoracearum*. Well developed fibrosin bodies were abundant in the conidia of all collections. Germination of conidia from a collection of powdery mildew of greenhouse cucumbers was observed on glass slides, and a number of forked germ tubes developed. Well developed fibrosin bodies have been reported in *Sphaerotheca* by several workers and are not known in *Erysiphe*. Forked germ tubes have not been reported in *Erysiphe*. I have examined a number of collections of Ohio powdery mildews on several hosts and have observed well developed fibrosin bodies in all of those collections known to be *Sphaerotheca*, while none have been observed in collections known to be *Erysiphe*. Observations were also made of a number of collections of powdery mildews of unknown identity. The presence or absence of well developed fibrosin bodies and the type of conidiophore (conidia borne in chains or singly) are reported for these collections in the host index.

It appears likely that some of the confusion that exists today in the identity of some powdery mildew fungi of economic importance, and also in the conflicting reports of host range, may be clarified by a study of the conidial stages of these fungi. Fresh material must be used to determine most of the characteristics referred to above. It is hoped that a future detailed study of the Ohio powdery mildews may provide further evidence of the value of the characteristics of the imperfect states for identification purposes.

In 1910, O'Kane published a paper on the Ohio powdery mildews which included 21 species and about 100 host-fungus associations (O'Kane, 1910). In this paper, 24 species and more than 320 host-fungus associations are reported. The present list is based on herbarium collections and published reports. The majority of the collections are in The Ohio State University fungus collections. Collections of Ohio powdery mildew fungi in herbaria of Oberlin College (OC), Miami University (MU), University of Cincinnati (CINC), and the National Fungus Collections (NFC) were also examined. Where specimens in these herbaria were from counties not represented in the OSU fungus collections, they are included in the index. Where a listing is based on a published report and not substantiated by a collection, the appropriate citation is included.

Many of the new Ohio records are based on collections by the author. Some of these have been published as first reports for the United States as well as for Ohio (Ellett, 1963). Others are reported here for the first time. There has been no concentrated effort by the author to collect powdery mildew fungi from everywhere in Ohio. Many of the host-fungus associations reported here certainly occur in every Ohio county. Also, with intensive collecting, it is likely that the number of hosts of powdery mildew fungi in Ohio would be greatly increased.

In the index which follows, the species concept of Salmon has been followed for the most part, although it is likely that a narrower species concept will be adopted as a result of more recent contributions. For each species the name and author citation used is that found to be in accordance with present nomenclatural rules, as demonstrated by Cooke (1952), Schmitt (1955), and Junell (1965). The varieties of *Microsphaera penicillata* (*M. alni*) have not been listed separately. *Sphaerotheca macularis*, as used in this paper, includes both *S. humuli* and *S. humuli* var *fuliginea* of Salmon's 1900 monograph, which are sometimes considered to be distinct species, distinguished by the size of the cells in the outer wall of the perithecium.

The nomenclature for the hosts is from *Gray's Manual of Botany*, 8th edition, or from Bailey's *Manual of Cultivated Plants*. OSU and OARDC used in the index are abbreviations for The Ohio State University and the Ohio Agricultural Research and Development Center.

I wish to express my thanks to Dr. Wm. Bridge Cooke and to Dr. John Schmitt

for valuable discussions and advice; to Dr. Clara Weishaupt, Curator of the Herbarium, The Ohio State University, for identifications of host plants; to the Curators of the herbaria of the University of Cincinnati, Miami University, Oberlin College, and the Ohio Agricultural Research and Development Center; and to Dr. C. R. Benjamin, Curator, National Fungus Collections, Beltsville.

INDEX OF OHIO ERYSIPHACEAE WITH THEIR HOSTS AND OCCURRENCE BY COUNTY

Erysiphe cichoracearum DC. ex Mérat. Appendages simple; asci several; ascospores usually two; condidia produced in a chain; appressoria are reported to be not lobed. *Erysiphe galeopsidis* is similar to *E. cichoracearum*, but is reported to have lobed haustoria, and ascospores that remain immature on the living host (Salmon, 1900; Homma, 1937). In this paper, *E. galeopsidis* is not considered as a separate species.

Acalypha rhomboidea Raf. Franklin.

Achillea millefolium L. Franklin, Vinton. Observed for several years in the conidial stage on plants in OSU horticultural garden. Fibrosin bodies were not evident in the collections checked. *E. cichoracearum* has been reported on this genus from several countries (Blumer, 1933; Salmon, 1900; Sawada, 1951; United States Department of Agriculture, 1960).

Actinomeris alternifolia (L.) DC. Cuyahoga, Fairfield, Franklin, Licking, Lorain (OC), Lucas (NFC).

Ageratum conyzoides L. Franklin. Observed each year since 1959 (Ellett, 1963).

Ambrosia artemisiifolia L. Butler (MU), Cuyahoga, Franklin, Hamilton, Lake (MU), Mahoning, Wayne, Williams.

A. trifida L. Butler, Cuyahoga, Fairfield, Franklin, Hamilton, Lorain (OC), Licking (OC), Montgomery (MU), Muskingum.

Arctium minus (Hill) Bernh. Franklin. Probably *E. cichoracearum*, although *Sphaerotheca* has also been reported on species of *Arctium* (Blumer, 1933; Homma, 1937). Only conidia have been observed on the Ohio collections.

Asclepias syriaca L. Cuyahoga.

A. tuberosa L. Franklin, Wayne. On plants in perennial gardens, OSU and OARDC. Only a few perithecia have been seen. *Microsphaera diffusa* has also been reported on this host (Greene, 1965).

Aster cordifolius L. Butler (MU), Franklin, Coshocton, Pike. Cuyahoga (Claassen, 1897). Because *E. cichoracearum* is the only powdery mildew recorded on *Aster* in the United States, all collections are listed here, even though perithecia are not always present.

A. ericoides L. Franklin, Hamilton (MU), Licking.

A. laevis L. Coshocton, Cuyahoga, Hamilton.

A. macrophyllus L. Lorain (OC).

A. novae-angliae L. Franklin.

A. novi-belgii L. Reported from Portage County (Claassen, 1899). A Claassen collection in the OSU fungus collections identified as *A. novi-belgii* is not this species.

A. pilosus Willd. Coshocton, Franklin.

A. prenanthoides Muhl. Cuyahoga, Highland, Lorain (OC).

A. puniceus L. Fairfield, Franklin, Licking. Geauga (Claassen, 1899).

A. sagittifolius Wedemeyer. Coshocton, Franklin.

A. shortii Lindl. Franklin, Hamilton (CINC) (MU).

A. simplex Willd. Reported from Cuyahoga County (Claassen, 1896). A Claassen collection in OSU collections labeled as *A. paniculatus* Lam. (*A. simplex* Willd.) is not this species, but *A. prenanthoides* Muhl.

A. undulatus L. Coshocton, Ross.

Chelone glabra L. Champaign, Lorain (OC).

Chrysanthemum morifolium (Ramat.) Hemsl. Common in Ohio, but there are no records of the perithecial stage. Often serious on susceptible varieties in greenhouses.

Cirsium altissimum (L.) Spreng. Butler, Franklin.

Coreopsis verticillata L. Franklin.

Cucumis sativus L. Powdery mildew on cucurbits in the United States is usually considered to be *E. cichoracearum*. This rests on inoculation experiments, because the perithecial stage is not usually present (United States Department of Agriculture, 1960). However, recent studies indicate that at least some of the cucurbit mildew in the United States may be *Sphaerotheca* (Kable and Ballantyne, 1963; Yarwood and Gardner, 1964). See note under this host under *Oidium*. Powdery mildew is common in Ohio on this and on the following two species.

Cucurbita maxima Dcne. See note under *Cucumis sativus*.

C. pepo L. See note under *Cucumis sativus*.

Dahlia pinnata Cav. Franklin, Muskingum.

Eupatorium fistulosum Barratt. Cuyahoga.
E. perfoliatum L. Butler, Cuyahoga, Franklin, Lorain (OC).
E. purpureum L. Hocking. Cuyahoga (Claassen, 1897).
E. rugosum Houtt. Coshocton.
Galium aparine L. Erie, Warren (conidia only).
Hackelia virginiana (L.) I. M. Johnston. Hamilton, Ottawa.
Helianthus annuus L. Butler.
H. decapetalus L. Franklin.
H. doronicoides Lam. Fairfield (NFC).
H. giganteus L. Pike.
H. kellermani Britt. Franklin.
H. strumosus L. Licking (OC). Cuyahoga (Claassen, 1897).
H. tuberosus L. Butler (MU), Fairfield, Franklin, Hamilton (MU), Lorain (OC), Ross, Sandusky.
Hibiscus palustris L. Franklin. The collection was made in the OSU botany garden from plants which were hybrid segregates of *H. palustris* with other species of *Hibiscus*.
Hydrophyllum appendiculatum Michx. Franklin.
H. canadense L. Jefferson.
H. macrophyllum Nutt. Butler, Darke, Fairfield, Franklin, Hamilton (CINC), Ross.
H. virginianum L. Mahoning.
Lactuca biennis (Moench) Fern. Madison, Pike.
L. floridana (L.) Gaertn. Scioto. The perithecial stage is not present on these collections of *Lactuca*. *E. cichoracearum* is the powdery mildew commonly reported on lettuce in the United States, but *Sphaerotheca* is also known on this genus (Homma, 1937; Salmon, 1900; United States Department of Agriculture, 1960).
Liatris spicata Willd. Franklin.
Mentha arvensis L. Franklin.
Monarda clinopodia L. Scioto. Perithecia are not present on this collection, but the few reports of powdery mildew on *Monarda* in the USA are of *E. cichoracearum* (Greene, 1965; Ellett, 1963).
M. didyma L. Franklin, Wayne. Has been abundant on plants in perennial gardens at OSU and OARDC.
Parietaria pennsylvanica Muhl. Franklin, Hamilton, Putnam. Erie (Brian, 1912).
Phlox divaricata L. Hamilton, Lorain (OC), Lucas, Williams.
P. paniculata L. Cuyahoga, Fairfield, Franklin, Hancock, Huron, Muskingum, Pike, Wayne.
Pilea pumila (L.) Gray. Hamilton. Perithecia are not present, but the only powdery mildew reported on the host is *E. cichoracearum* (Salmon, 1900; United States Department of Agriculture, 1960). *Erysiphe polygoni* is reported on another species of *Pilea* in Japan (Homma, 1937).
Plantago major L. Butler (MU), Montgomery (MU).
P. rugelii Dcne. Coshocton (NFC), Franklin.
Rudbeckia laciniata L. Franklin, Seneca (NFC).
Salvia farinacea Benth. Franklin, Wayne.
Scutellaria lateriflora L. Cuyahoga, Lorain (OC).
Solidago altissima L. Franklin, Summit. Perithecia are not present on all of the collections on the *Solidago* species.
S. canadensis L. Cuyahoga, Hamilton, Lorain (OC).
S. flexicaulis L. Hamilton (CINC).
S. patula Muhl. Champaign.
Stachys riddellii House. Hamilton, Scioto.
S. tenuifolia Willd. Lorain (OC) (NFC).
Stokesia laevis Greene. Franklin. Collected in the perennial garden, OSU campus, October, 1962.
Taraxacum officinale Weber. Reported from Erie County (Brian, 1912) as *E. montagnei* Lev. (=*E. cichoracearum*). Specimen in OSU fungus collections by Brian, from Ottawa County and identified as *Erysiphe*, is *Sphaerotheca macularis*. Salmon (1900) suggests that *Erysiphe* probably does not occur on *Taraxacum*.
Tragopogon porrifolius L. Butler (MU), Franklin. The Butler collection was made in 1908 by Bruce Fink.
Valeriana pauciflora Michx. Hamilton (CINC).
Verbena hastata L. Butler, Cuyahoga, Fairfield (NFC), Franklin.
V. hybrida Voss. Franklin. Perithecia were not present on these cultivated plants. Reported as general on this host in the United States (United States Department of Agriculture, 1960). *Microsphaera ferruginea* Erikss. has been reported from Europe (Blumer, 1933; Salmon, 1900). *Sphaerotheca* has been reported from Queensland (Clare, 1964).
V. urticifolia L. Auglaize, Butler (MU), Coshocton (NFC), Cuyahoga, Fairfield, Franklin, Hamilton, Hocking, Mahoning, Wyandot.
V. simplex Lehm. Ottawa.
Vernonia altissima Nutt. Cuyahoga, Franklin, Huron, Portage.
V. fasiculata Michx. Butler (MU), Cuyahoga, Franklin.

Xanthium pennsylvanicum Wallr. Lorain (OC). Conidial stage on plants in OSU greenhouse. Conidia in chains, without well-developed fibrosin bodies.
Zinnia elegans Jacq. Franklin, Lorain (OC). Common and destructive on this garden ornamental. *Sphaerotheca* has been reported on this host in India (Jhooty, 1965) and in several other countries (Hirata, 1966).

Erysiphe graminis DC. ex Mérat. Appendages simple; asci several; ascospores eight; conidia in a chain; conidiophore swollen at the base; on Gramineae.

Agropyron repens (L.) Beauv. Conidial stage observed frequently.
Anthoxanthum odoratum L. Wayne. Conidial stage. This collection was by Gilbert Daft, OARDC, and is the first North American report.
Avena sativa L. Observed in the conidial stage in Franklin, Summit, and Wayne Counties and on experimental plants in the greenhouse.
Calamagrostis canadensis (Michx.) Nutt. Reported from Ohio (Sprague, 1950).
Dactylis glomerata L. Franklin. Conidial stage.
Elymus riparius Wieg. Franklin. Conidial stage.
E. virginicus L. Franklin. Conidial stage.
Hordeum distichon L. Reported from Ohio (Sprague, 1950).
H. vulgare L. Clinton, Darke, Franklin. Occurs wherever the host is cultivated in Ohio.
Poa compressa L. Franklin, Wayne.
P. pratensis L. Butler (CINC), Champaign, Franklin, Hamilton. Frequent throughout Ohio.
Secale cereale L. Reported from Ohio in 1920 (United States Department of Agriculture, 1921). Observed in Franklin County in the conidial stage and in the perithecial stage in Champaign County.
Triticum aestivum L. Athens, Franklin, Lake (NFC), Mahoning, Ottawa, Seneca, Wayne. Throughout Ohio and increasing in severity in recent years (Ellett, 1964).
T. spelta L. Ashtabula.

Erysiphe polygoni DC. ex St.-Am. Appendages simple; asci several; ascospores three to eight; mature conidia produced singly; appressoria are reported to be lobed.

Amphicarpa bracteata (L.) Fern. Butler (MU), Franklin.
Anemonella thalictroides (L.) Spach. Champaign. Conidial stage, but is probably *E. polygoni*, which has been reported on this host from Iowa (Gilman and Archer, 1929) and from Wisconsin (Greene, 1965).
Anemone virginiana L. Hamilton (CINC).
Aquilegia canadensis L. Champaign, Erie, Franklin. Cuyahoga (Claassen, 1896).
Aquilegia sp. (cult.) Franklin.
Baptisia tinctoria (L.) R. Br. Cuyahoga (Claassen, 1913).
Caltha palustris L. Franklin, Stark, Summit.
Clematis virginiana L. Coshocton, Franklin, Hamilton, Pike. Cuyahoga (Claassen, 1899).
Delphinium sp. (cult.) Miami.
Desmodium canescens (L.) DC. Franklin (O'Kane, 1910).
Geranium maculatum L. Cuyahoga (NFC).
Hydrangea arborescens L. Highland.
Liriodendron tulipifera L. Butler (MU), Pickaway, Preble.
Lupinus perennis L. Erie, Lucas.
Oenothera biennis L. Butler (MU), Franklin, Lake.
Phaseolus vulgaris L. Franklin. Conidial stage.
Pisum sativum L. Wayne. See Van Hook (1906).
Polygonum aviculare L. Clermont (CINC), Clinton, Cuyahoga, Erie, Franklin, Huron (NFC), Lorain (OC), Lucas (NFC), Ottawa, Sandusky, Warren (MU), Wayne.
P. erectum L. Belmont, Butler (MU), Fairfield, Franklin, Hamilton (MU), Jefferson, Lorain (OC), Montgomery (MU), Ottawa, Wayne.
P. scandens L. Pickaway.
Ranunculus abortivus L. Butler (MU), Erie, Wayne, Wyandot. Cuyahoga (Claassen, 1899).
R. acris L. Mahoning. Cuyahoga, Portage, Lake (Claassen, 1897, 1899).
R. recurvatus Poir. Ashland (Conidial stage). Cuyahoga (Claassen, 1899).
Thalictrum sp. Lucas.
Thalictrum dasycarpum Fisch. and Lall. Hamilton. Lake (Claassen, 1899).
T. polygamum Muhl. Champaign.
Trifolium pratense L. Coshocton (NFC), Franklin, Pike, Summit, Wayne. Common in Ohio, but known only in the conidial stage.

Microsphaera penicillata (Wallr. ex Fries) Lév. (M. alni DC. ex Wint.). Appendages of *Microsphaera* species are dichotomously branched at the apex;

asci several; matured conidia are solitary. Appendage characteristics are useful in separating the various species of *Microsphaera*.

Alnus incana (L.) Willd. Medina.
Apios americana Medic. Erie (Brian, 1912).
Betula lenta L. Cuyahoga, Geauga, Lake (Claassen, 1897).
Campsis radicans (L.) Seem. Brown (NFC), Pickaway.
Carpinus caroliniana Walt. Lorain (OC), Wayne.
Castanea dentata (Marsh.) Borkh. Cuyahoga, Fairfield, Lake, Ross.
Catalpa bignonioides Walt. Butler (NFC), Franklin, Lorain, Lucas, Summit, Wayne.
C. speciosa Warder. Butler (MU).
Cornus alternifolia L. Champaign, Coshocton, Hocking. Cuyahoga, Geauga (Claassen, 1897).
C. racemosa Lam. Cuyahoga.
Corylus americana Walt. Champaign, Wayne.
Epigaea repens L. Fairfield, Hocking.
Euonymus atropurpureus Jacq. Champaign, Franklin, Pike, Union.
Fagus grandifolia Ehrh. Butler (MU), Lorain (OC).
Fraxinus ornus L. Pickaway. This appears to be the only record of *Microsphaera* on this host (Ellett, 1963). *Phyllactinia* was present on the same leaves.
Gaylussacia sp. Fulton.
G. baccata (Wang.) K. Koch. Fairfield. Summit (Claassen, 1897)
Gleditsia tricanthos L. Brown, Butler, Franklin, Hamilton, Highland, Licking, Montgomery (MU), Putnam, Warren.
Juglans nigra L. Butler, Franklin, Putnam.
Lathyrus palustris L. Erie, Lake, Licking (OC).
Ligustrum vulgare L. Franklin, Hamilton (NFC).
Lonicera canadensis Bartr. Cuyahoga.
L. dioica L. Geauga, Summit (Claassen, 1897) on *L. glauca* (=*L. dioica* L.).
L. oblongifolia (Goldie) Hook. Cuyahoga (NFC).
Magnolia liliflora Desr. Franklin.
M. stellata Maxim. Franklin.
Menispermum canadense L. Butler. Lake (Claassen, 1897).
Nemopanthus mucronata (L.) Trel. Lorain (OC).
Ostrya virginiana (Mill.) K. Koch. Lorain (OC).
Platanus acerifolia Willd. Franklin.
P. occidentalis L. Butler, Cuyahoga, Fairfield, Franklin, Hamilton, Montgomery (MU), Wayne.
Quercus alba L. Fairfield, Hamilton (OC), Lucas, Lawrence, Ross. Cuyahoga, Geauga, Summit (Claassen, 1897).
Q. coccinea Muenchh. Franklin, Lawrence (NFC).
Q. macrocarpa Michx. Franklin, Hamilton (MU).
Q. muehlenbergii Engelm. Franklin.
Q. palustris Muenchh. Butler (MU), Pickaway.
Q. prinus L. Geauga (Claassen, 1897).
Q. robur L. Franklin, Hancock.
Q. rubra L. Butler (MU), Franklin, Lawrence (NFC), Ross, Pickaway. Summit (Claassen, 1897).
Q. velutina Lam. Adams, Fairfield, Lawrence, Ross.
Rhododendron japonicum Suringar. Franklin, Wayne.
R. molle Don. Franklin.
Sambucus canadensis L. Cuyahoga, Lorain (OC).
Syringa chinensis Willd. Franklin, Pickaway.
S. vulgaris L. Ashtabula, Butler, Cuyahoga, Fairfield, Franklin, Hamilton, Highland (MU), Holmes, Lorain (OC), Lucas, Ottawa, Putnam, Summit, Wayne.
Vaccinium sp. Huron.
V. corymbosum L. Portage, Lorain (OC).
V. macrocarpon Ait. Reported from Ohio (United States Department of Agriculture, 1960).
V. vacillans Torr. Fairfield, Lake, Meigs, Portage. Cuyahoga, Geauga, Summit (Claassen, 1897).
Viburnum acerifolium L. Cuyahoga, Lorain (OC), Wayne.
V. cassinoides L. Ottawa.
V. lentago L. Erie, Lucas, Ottawa.
V. prunifolium L. Champaign, Franklin.

Microsphaera diffusa G. W. Clint. and Pk.

Apios americana Medic. Lake (Claassen, 1897).
Desmodium canadense (L.) DC. Lake (Claassen, 1897).
D. canescens (L.) DC. Cuyahoga, Franklin, Holmes.

D. dillenii Darl. Cuyahoga.
D. nudiflorum (L.) DC. Franklin.
Lespedeza sp. Hocking. This host was determined to be *L. stipulacea* Maxim. or *L. striata* (Thunb.) H. & A.
Lycium halimifolium Mill. Reported from Ohio (United States Department of Agriculture, 1960).
Symphoricarpos albus (L.) Blake. Erie, Franklin.
S. occidentalis Hook. Butler.
S. orbiculatus Moench. Butler (MU), Franklin, Hamilton, Pickaway.
S. chenaultii Rehd. Pickaway.

Microsphaera euphorbiae (Pk.) Berk. & Curt.

Euphorbia corollata L. Butler (MU), Franklin, Lorain, Lucas, Ross, Wood.
E. maculata L. Pickaway. Conidial stage present. Probably *M. euphorbiae*, but *Sphaerotheca* is reported on the genus from Europe (Blumer, 1933).

Microsphaera grossulariae Wallr. ex Lév.

Sambucus canadensis L. Butler, Champaign, Cuyahoga, Delaware, Fairfield, Franklin, Hamilton, Lake (MU), Lorain (OC), Montgomery (MU), Wayne.
S. pubens Michx. Cuyahoga (OC).

Microsphaera russellii G. W. Clint.

Oxalis europaea Jord. Butler.
O. stricta L. Butler (MU), Cuyahoga (NFC), Franklin, Hamilton, Lucas (OC).

Phyllactinia guttata (Wallr. ex Fr.) Lév. (*P. corylea* Pers. ex Karst.). Appendages acicular, with swollen bases; matured conidia clavate, produced singly.

Alnus rugosa (Du Roi) Spreng. Licking.
Carpinus caroliniana Walt. Fairfield, Lorain (OC).
Castanea dentata (Marsh.) Borkh. Adams, Cuyahoga (NFC), Hocking, Knox, Lawrence, Vinton.
Catalpa bignonioides Walt. Fairfield, Lucas.
Celastrus scandens L. Erie, Licking.
Cornus florida L. Fairfield.
Crataegus succulenta Link. Ottawa.
Fagus grandifolia Ehrh. Butler, Franklin, Lorain (OC), Montgomery (NFC).
Fraxinus sp. Butler, Franklin, Williams.
F. americana L. Butler (MU), Franklin, Lorain (OC). Montgomery (Fink, 1921).
F. nigra Marsh. Franklin.
F. ornus L. Pickaway. Reported from several countries in Europe (Blumer, 1933) but this is the only report for the United States.
Juglans nigra L. Butler. Montgomery (Fink, 1921).
Magnolia accuminata L. Franklin. Cuyahoga (Claassen, 1897).
Morus alba L. Butler (MU). *Uncinula* is also present on this collection.
M. rubra L. Butler, Montgomery (Fink, 1921).
Quercus marilandica Muenchh. Lawrence.
Q. nigra L. Fairfield (NFC). A collection by W. A. Kellerman in 1882. If host was correctly determined, it must have been introduced. It is possible that the host was *Q. velutina*.
Q. palustris Muenchh. Lucas, Wyandot.
Q. rubra L. Fairfield.
Ulmus americana L. Lorain (OC).

Podosphaera biuncinata Cke. & Pk. Appendages of *Podosphaera* species are dichotomously branched at the apex; one ascus; conidia in a chain.

Hamamelis vernalis Sarg. Franklin.
H. virginiana L. Cuyahoga, Franklin, Huron, Summit.

Podosphaera clandestina (Wallr. ex Fr.) Lév. (*P. oxyacanthae* (DC.) DBy.)

Crataegus sp. Cuyahoga (NFC), Hamilton, Hocking, Mahoning, Morgan, Ottawa, Williams.
C. calpodendron (Ehrh.) Medic. Summit (Claassen, 1897) on *C. tomentosa* (= ? *C. calpodendron*).
C. crus-galli L. Cuyahoga (Claassen, 1897).
Cydonia oblonga Mill. Butler (MU). Collection by Bruce Fink in 1908.
Prunus sp. (cult. plum). Franklin.
P. angustifolia Marsh. Franklin (Selby, 1893) on *P. chicasa* (= *P. angustifolia*).
Prunus cerasus L. Butler, Brown, Clermont, Franklin, Hamilton, Hancock, Hardin, Highland, Lorain (OC), Montgomery, Morgan, Ottawa, Summit, Wayne, Williams.

P. cerasifera Ehrh. Franklin, Pickaway.
P. virginiana L. Erie.
Pyrus malus L. Lorain (OC).
Spiraea tomentosa L. Fairfield (NFC).

Podosphaera leucotricha (Ell. & Ev.) Salm.

Pyrus baccata L. Pickaway.
P. malus L. Athens, Franklin, Lake, Lawrence, Ottawa, Wayne. In recent years, powdery mildew has become more prevalent on this host in Ohio.
P. tschonoskii Maxim. Pickaway.

Sphaerotheca macularis (Wallr. ex Fr.) Lind. (*S. humuli* (DC.) Burr.). Appendages simple; one ascus; conidia in chains.

Agrimonia parviflora Ait. Franklin. Conidial stage.
A. striata Michx. Lorain (OC).
Bidens cernua L. Coshocton.
B. comosa (Gray) Weig. Butler (MU).
B. coronata (L.) Britt. Franklin.
B. discoidea (T. & G.) Britt. Hamilton (MU).
B. frondosa L. Brown, Cuyahoga, Franklin, Hamilton, Lorain (OC), Montgomery (MU), Putnam.
Cacalia muhlenbergii (Sch.-Bip.) Fern. Cuyahoga (NFC).
Erechtites hieracifolia (L.) Raf. Franklin, Licking, Lorain (OC). Geauga, Summit, Medina, (Claassen, 1897).
Erigeron annuus (L.) Pers. Lorain (OC) (NFC).
Fragaria chiloensis (L.) Duchesne. Reported from Ohio (United States Department of Agriculture, 1919).
Geranium maculatum L. Champaign, Franklin, Huron.
Geum canadense Jacq. Lorain (OC), Medina, Wyandot.
G. laciniatum Murr. Ashtabula.
G. vernum (Raf.) T. & G. Brown, Franklin.
G. virginianum L. Lorain (OC).
Humulus scandens Merr. Clark, Franklin, Conidial stage.
Pedicularis lanceolata Michx. Lake (Claassen, 1897).
Phlox paniculata L. Reported from Ohio (United States Department of Agriculture, 1920).
Potentilla fruticosa L. Wyandot.
Prenanthes alba L. Cuyahoga.
P. altissimus L. Cuyahoga, Franklin.
Prunella vulgaris L. Lorain (OC).
Rhus glabra L. Brown. Cuyahoga (Claassen, 1897).
R. typhina L. Ashtabula, Highland.
Rosa sp. (native). Erie. Perithecia are abundant on this collection.
Rubus sp. (blackberry). Reported from Ohio (United States Department of Agriculture, 1920).
Rubus sp. (dewberry). Reported from Ohio (United States Department of Agriculture, 1960).
Rubus idaeus L. Ashtabula.
R. occidentalis L. Reported from Ohio (United States Department of Agriculture, 1960).
R. odoratus L. Cuyahoga.
Sanguisorba canadensis L. Champaign, Franklin.
Sonchus asper (L.) Hill. Pike, Wayne.
Taraxacum officinale Weber. Auglaize, Butler, Cuyahoga, Erie, Franklin, Hamilton, Lorain, Lucas, Ottawa, Wayne.
Veronica incana L. Cuyahoga.
V. longifolia L. Franklin, Wayne. On plants in perennial gardens, OSU and OARDC.
V. serpyllifolia L. Franklin.

Sphaerotheca mors-uvae (Schw.) Berk. & Curt. The mycelium in this species becomes blackish-brown by the time perithecia develop.

Ribes cynosbati L. Erie, Hardin.
R. grossularia L. Erie.
R. sativum Syme. Holmes, Lucas.

Sphaerotheca pannosa (Wallr. ex Fr.) Lév.

Rosa sp. (cultivated). Powdery mildew in the conidial stage is common throughout Ohio on garden and greenhouse roses. Perithecia are not found. *Sphaerotheca macularis* is also reported on roses in America. Well-developed fibrosin bodies are present in the few Ohio collections that I have checked.

Rosa eglanteria L. Hamilton.
R. multiflora Thunb. Franklin.
Prunus persica (L.) Batsch. Powdery mildew is occasionally observed in Ohio on peach fruits and leaves, and is listed as *S. pannosa* even though perithecia are not present. *Podosphaera clandestina* also occurs on peach and, in the absence of perithecia, a particular species should probably not be reported (Keil and Wilson, 1961).

Sphaerotheca phytoptophila Kell. & Sw.

Celtis occidentalis L. Athens, Brown, Butler (MU), Franklin, Hamilton, Morgan, Morrow, Preble. Found in association with a mite (*Aceria* sp.) on abnormal growth of twigs and branches of the host—the condition referred to as witches'-broom. This association has recently been studied (Snetsinger and Himelick, 1957).

Uncinula adunca (Wallr. ex Fr.) Lév. (*U. salicis* DC. ex Wint.). Appendages are coiled at the tip; several asci; mature conidia usually produced singly. Appendage characteristics are useful in separating the species.

Populus deltoides Marsh. Erie.
P. tremuloides Michx. Cuyahoga (NFC), Erie.
Populus sp. Lake (MU).
Salix cordata Michx. Auglaize, Cuyahoga, Franklin, Madison.
S. discolor Muhl. Lorain (OC) (NFC).
S. glaucophylloides Fern. Erie.
S. gracilis Anderss. Franklin.
S. humilis Marsh. Fairfield (O'Kane, 1910).
S. nigra Marsh. Butler, Franklin, Hamilton.
Salix sp. Butler, Erie, Fairfield, Franklin, Licking, Summit, Union, Wood.

Uncinula adunca (Wallr. ex Fr.) Lév. (*U. salicis* DC. ex Wint.). Appendages

Acer rubrum L. Cuyahoga, Delaware, Fairfield, Franklin, Hocking, Lorain (OC), Ross, Wayne.
A. saccharinum L. Cuyahoga, Fairfield, Franklin, Lorain (OC), Madison, Pickaway.
A. saccharum Marsh. Butler, Cuyahoga, Franklin, Hamilton.

Uncinula clintonii Pk.

Tilia americana L. Butler, Cuyahoga, Franklin, Lorain (OC), Wayne.

Uncinula flexuosa Pk.

Aesculus glabra Willd. Butler (MU), Franklin.
A. hippocastanum L. Franklin, Lorain (OC), Summit, Wayne.
A. octandra Marsh. Lawrence.

Uncinula geniculata Gerard.

Morus rubra L. Butler.

Uncinula macrospora Pk.

Ulmus americana L. Butler (MU), Fairfield, Franklin, Hamilton (MU) (NFC), Lorain (OC), Lucas, Pickaway, Wyandot.
U. rubra Muhl. Fairfield, Fayette, Franklin, Warren, Wayne.

Uncinula necator (Schw.) Burr.

Parthenocissus quinquefolia (L.) Planch. Butler (MU), Cuyahoga, Franklin, Hamilton, Hardin, Hocking, Huron, Licking, Lorain, Lucas.
Vitis labruscana Bailey (cultivated grape). Butler (MU), Columbiana, Delaware, Franklin, Lorain, Lucas, Pickaway, Sandusky.
V. riparia Michx. Licking (OC).
V. vulpina L. Delaware, Hamilton.

Uncinula parvula Cke. & Pk.

Celtis occidentalis L. Butler.

Oidium sensu Sacc. Included here are hosts on which only conidia have been observed. Many of these have recently been reported as new records for Ohio or the United States (Ellett, 1963). Others are reported here for the first time.

Achimenes grandiflora (Schiede) DC. On experimental plants, OSU botany greenhouses. Conidia are in chains and without well developed fibrosin bodies.

Antirrhinum majus L. Observed on seedlings in a greenhouse in Hamilton County and on flowering plants in a greenhouse in Franklin County. The disease was severe in both cases, and probably extends throughout Ohio. Perithecia have not been reported on this host, but the perithecial stage of *Erysiphe cichoracearum* does occur on *A. orontium* in Europe. The conidiophores of this *Oidium* on snapdragons in the United States are reported to be of the *E. cichoracearum* type (Baker and MacLean, 1950).

Artemisia latifolia Ledeb. Franklin. Plants in demonstration plots, OSU farm, 1965.

Begonia semperflorens Link & Otto. Franklin, Delaware. Occasionally destructive in greenhouses.

Brassica napobrassica Mill. Franklin. In demonstration plantings, OSU farm, 1965.

B. napus L. Franklin. In demonstration plantings, OSU farm, 1965.

B. rapa L. Franklin. In demonstration plantings, OSU farm, 1965.

Calendula officinalis L. Franklin. *E. cichoracearum*, *E. polygoni*, and *Sphaerotheca macularis* have been reported on this host (Blumer, 1933; Salmon, 1900; Moore, 1959; United States Department of Agriculture, 1960).

Chrysanthemum parthenium Pers. Franklin.

Cleome spinosa L. Franklin. *Sphaerotheca* has been reported on the host from Japan (Hirata, 1966).

Coreopsis grandiflora Hogg. Franklin. *Sphaerotheca macularis* and *Erysiphe cichoracearum* have been reported on species of *Coreopsis* (Shaw, 1958; United States Department of Agriculture, 1960).

Crataegus crus-galli L. Pickaway. *Podosphaera clandestina* and *Phyllactinia guttata* are reported on *Crataegus* (United States Department of Agriculture, 1960).

Crotalaria intermedia Kotschy. Franklin. On plants in demonstration plantings, OSU farm, 1965. A few immature perithecia of a species of *Erysiphe* are present.

Cucumis sativus L. Licking. In this collection, the conidia are in chains and have well developed fibrosin bodies. A number of the conidia germinated with forked germ tubes, which are characteristics of *Sphaerotheca*.

Dorstenia contrajerva L. Common on this tropical American plant in OSU botany greenhouses. The conidia are in chains and well developed fibrosin bodies are absent. *Sphaerotheca* is reported on this host in Japan (Hirata, 1966).

Euonymus japonicus L. Franklin. Observed frequently in greenhouses. *Microsphaera* species have been reported on *Euonymus* (Blumer, 1933; Salmon, 1900; United States Department of Agriculture, 1960).

Helenium tenuifolium Nutt. Franklin. *Erysiphe cichoracearum* has been reported frequently on *Helenium* (Salmon, 1900; United States Department of Agriculture, 1960).

Hydrangea macrophylla Ser. Champaign (NFC), Franklin, Muskingum, Wayne. Common on greenhouse plants. In a collection from OSU greenhouses, the conidia were borne singly, fibrosin bodies were absent, and the appressoria were lobed. In the United States, this powdery mildew has been commonly listed as *Erysiphe polygoni* (United States Department of Agriculture, 1960). *Microsphaera polonica* Siemaszko is considered to be the perfect stage of this hydrangea mildew in Queensland (Clare, 1964) and in England (Moore, 1959).

Kalanchoe blossfeldiana v. Poellnitz. Ashtabula, Franklin. In a collection from OSU greenhouses, conidia were borne singly, well developed fibrosin bodies were absent and appressoria were lobed. *Erysiphe* and *Sphaerotheca* have been reported on *Kalanchoe* spp. (Moore, 1959; United States Department of Agriculture, 1960).

Lamium purpureum L. Franklin.

Layia elegans Torr. & Gray. Franklin. On plants in OSU garden.

Myosotis sylvatica Hoffm. Franklin. *Erysiphe* is reported from Europe (Blumer, 1933; Moore, 1959). *Oidium* sp. is reported from Quebec (Canada Department of Agriculture, 1960).

Oxalis stricta L. Franklin. Common in OSU greenhouses. Conidia are borne singly and without well developed fibrosin bodies.

Pedilanthus tithymaloides Poit. Franklin. OSU botany greenhouses. Conidia are in chains and well developed fibrosin bodies are present.

Petunia hybrida Vilm. Franklin. Developed abundantly on plants in OSU greenhouses, March, 1961. *Oidium* has been reported from California, Minnesota, New York, West Virginia, and countries in Africa (Riley, 1956; United States Department of Agriculture, 1960; Wiehe, 1953; Yarwood, 1945). *Erysiphe cichoracearum* is reported on *Petunia* from Tanganyika Territory (Riley, 1960).

Platanus orientalis L. Lucas (NFC). This collection was labeled as *Oidium obductum* Ell. & Langl.

Polemonium reptans L. Champaign. On plants in Cedar Swamp. *Sphaerotheca* has been reported from Washington and Idaho on *P. micranthum* L. (Shaw, 1958). *Erysiphe cichoracearum* has been reported from Utah on *P. occidentale* Greene and *P. foliosissimum* Gray (Rhoads, 1946). *Erysiphe* and *Sphaerotheca* are reported on *P. caeruleum* from Japan (Homma, 1937).

Prunus avium L. Miami. On nursery plants.

P. besseyi Bailey. Miami. On nursery plants being used as understock.

Saintpaulia ionantha Wendl. Franklin, Medina. Probably fairly common, but difficult to see on this host. A report from Canada suggests that the species may be *E. cichoracearum*, because mildew developed on cucumber when inoculated with conidia from *Saintpaulia* (Canada Department of Agriculture, 1955). However, cucumber is also susceptible to *Sphaerotheca*.

Sedum acre L. Franklin. OSU botany greenhouse. *Erysiphe polygoni* is reported from Japan on several species of *Sedum* (Homma, 1937; Sawada, 1951).

Smithiantha fulgida (Ortgies) Voss ex Siebert and Voss. On experimental plants, OSU botany greenhouses. The conidia are in chains and without well developed fibrosin bodies.

Thalictrum sp. Perry. Conidia are borne singly and without well developed fibrosin bodies.

Vernonia anthelmintica Willd. Franklin. On plants in demonstration plots, OSU farm, 1965.

Vigna sinensis Savi. Franklin. On experimental plants in OSU botany greenhouses.

Wistaria sinensis Sweet. Franklin. Reported from California (Yarwood, 1945) as *Oidium* and from Texas (United States Department of Agriculture, 1960) as *Erysiphe* sp.

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